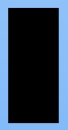
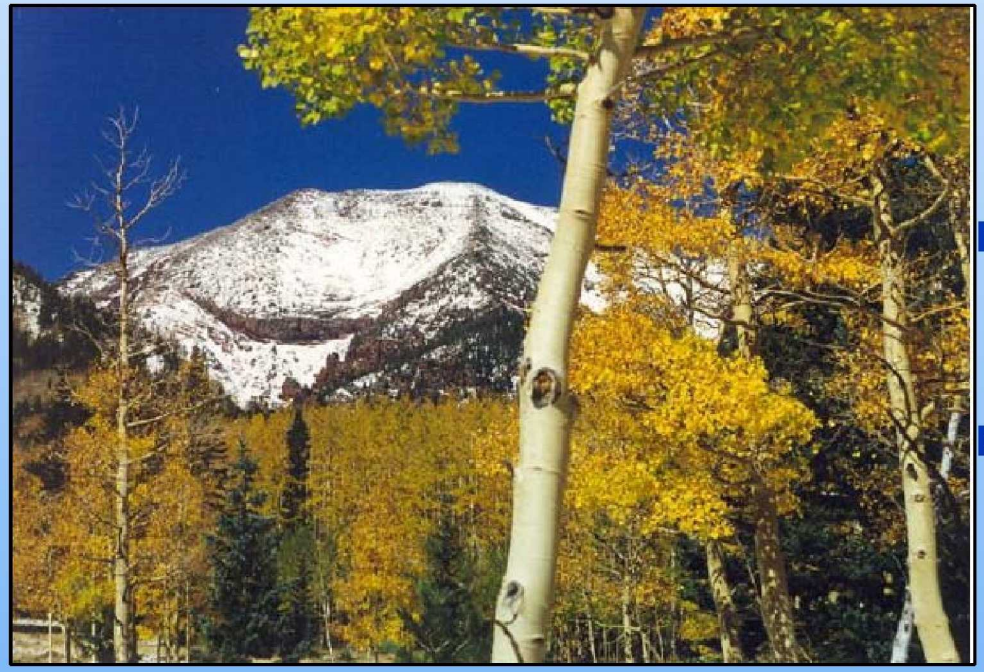
Volcanoes

Arizona Volcanoes

- Arizona is a great state to study volcanoes!
  - The three major kinds of volcanoes are all present in this state
- Stratovolcanoes can be found in the northern part of the state and Cinder Cones in the northern, eastern and western parts
- Shield volcanoes are located west of Phoenix



San Francisco Volcanic Field



- Many of the hills and mountains between Flagstaff and the Grand Canyon are geologically young (6 million years old) and extinct volcanoes of the San Francisco Volcanic Field
- San Francisco Peaks are the remains of eroded stratovolcanoes
- Humphrey's Peak Is the highest point in Arizona at 12,633 feet

Humphrey's Peak from the ISS

ISS014-E-17325

Sunset Crater

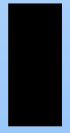
- Part of the San Francisco Volcanic Field in northern Arizona
- Is a type of volcano known as a cinder cone
- The state's youngest volcano
- Thought to have erupted in 1064 AD

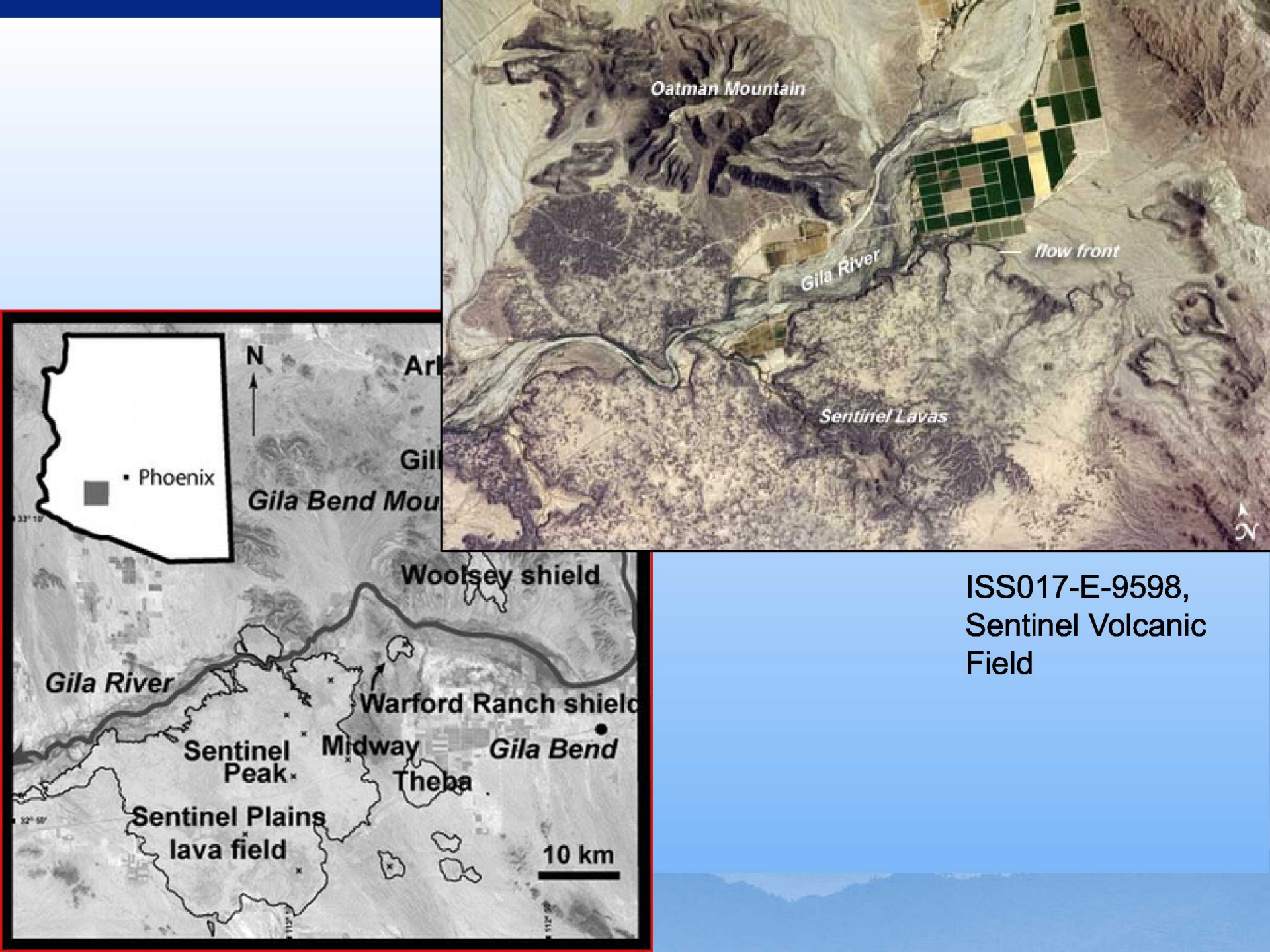
Sunset Crater from the ISS

ISS014-E-7244

Shield Volcanoes in Southwestern Arizona

- Found within the Sentinel-Arlington Volcanic Field
- 18 low shield volcanoes
- Located 60 – 70 km west of Phoenix





ISS017-E-9598, Sentinel Volcanic Field

What is the difference between a mountain and a volcano?

- Volcanoes are not formed by folding, crumpling, uplift or erosion
- Volcanoes are built by accumulation of their own eruptive products

Types of Volcanoes

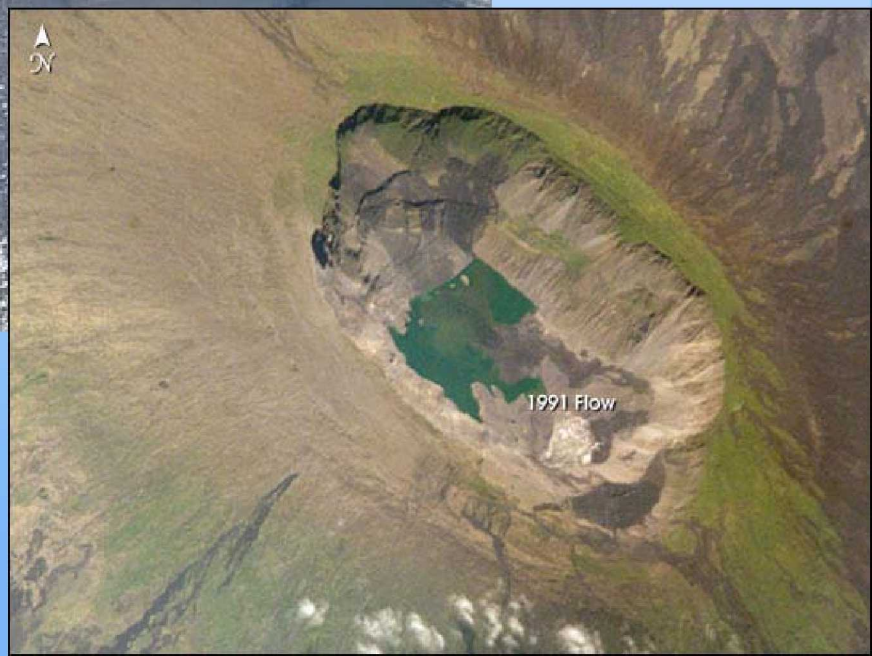
- Shield volcano
  - Broad, slightly domed
  - Primarily made of basaltic (fluid) lava
  - Generally large size
  - e.g., Mauna Loa in Hawaii

Island of Hawaii

STS099-701-8,
100 mm, Feb. 2002

Galapagos Islands

ISS005-E-6997



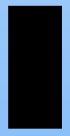
ISS004-E-13314, Galapagos Islands

Cinder Cones

- Built from ejected lava fragments
- Steep slope angle
- Rather small size
- Frequently occur in groups
- Usually a product of relatively gas-rich basaltic magma

Stratovolcanoes

- Also called composite cones
- Most are adjacent to the Pacific Ocean
- Large size
- Interbedded lavas and pyroclastics
- Most violent type of activity



Mt. St. Helens –stratovolcano

Mt. St. Helens following the 1980 eruption

Mt. St. Helens

Mt. St. Helens

ISS011-E-13762, 180 mm, Sept. 28, 2005

ISS005-E-8020, 800 mm, 07/02/2001, Mt. St. Helens

Stratovolcanoes

- Often produce nuée ardente
  - Fiery pyroclastic flow made of hot gases infused with ash
  - Flows down sides of a volcano at speeds up to 200 km (125 miles) per hour
- May produce a lahar - volcanic mudflow
  - Generally follow gullies and stream valleys
  - Can be generated when large volumes of ice and snow melt during an eruption
  - Others are generated when heavy rainfall saturates weathered volcanic debris
  - Lahars can be reactivated after an eruption

Mt. Pinatubo, Philippines - Lahars

STS090-E-707-28, 250 mm, April 24, 1998

Cascade Range

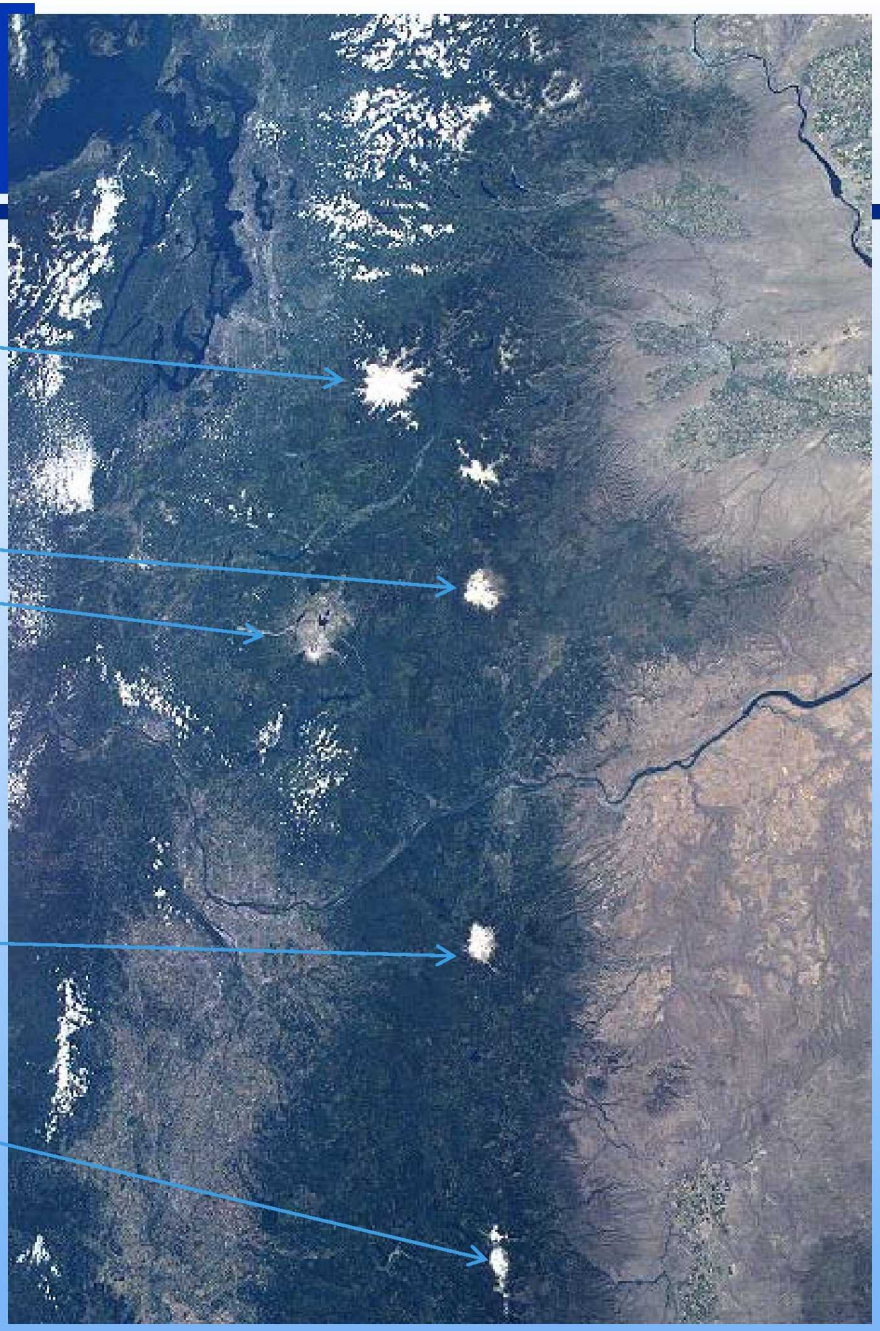
Mt. Rainier

Mt. Adams

Mt. St. Helens

Mt. Hood

Mt. Jefferson



ISS002-E-8293,
35mm, July 6, 2001

Where Does The Magma Come From ?

- Magma originates when essentially solid rock, located in the crust and upper mantle, melts
- Factors that influence the generation of magma from solid rock
  - Role of heat
    - Earth's natural temperature increases with depth (geothermal gradient) is not sufficient to melt rock at the lower crust and upper mantle

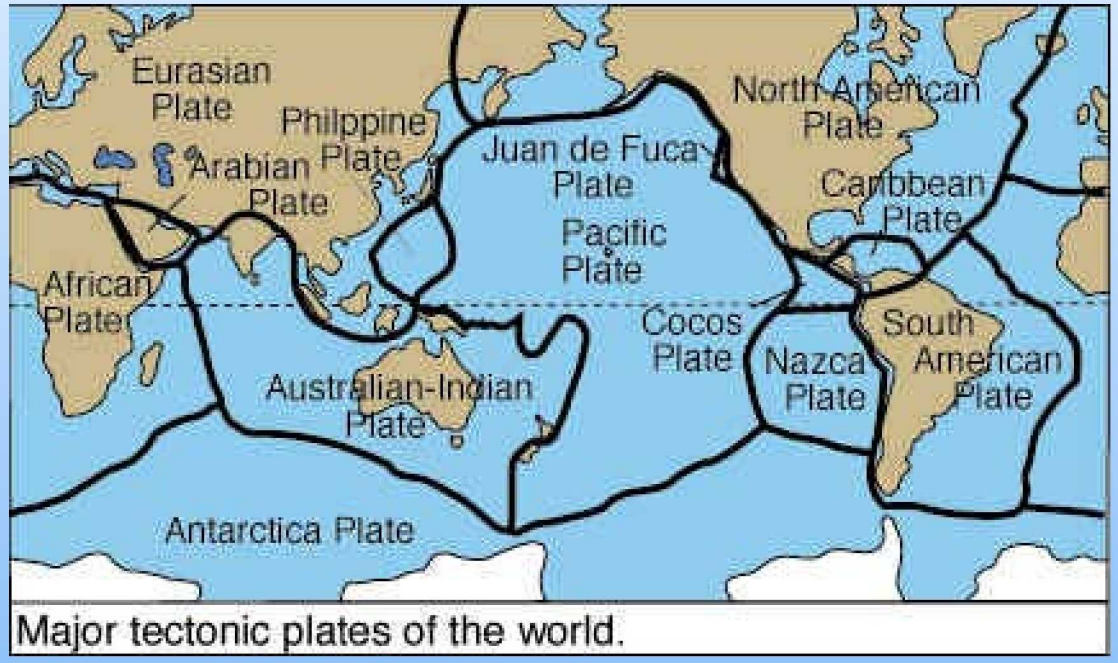
Magma

- Role of heat
  - Additional heat is generated by
    - Friction in subduction zones
    - Crustal rocks heated during subduction
      - hydrous minerals plays a big role in lowering the melting point of upper mantle and lower crustal materials to create magma

Distribution of Volcanoes

- Global distribution of volcanoes is not random
  - Most volcanoes are located on the margins of the ocean basins (intermediate, andesitic composition)
  - Second group is confined to the deep ocean basins (basaltic lavas)
  - Third group includes those found in the interiors of continents

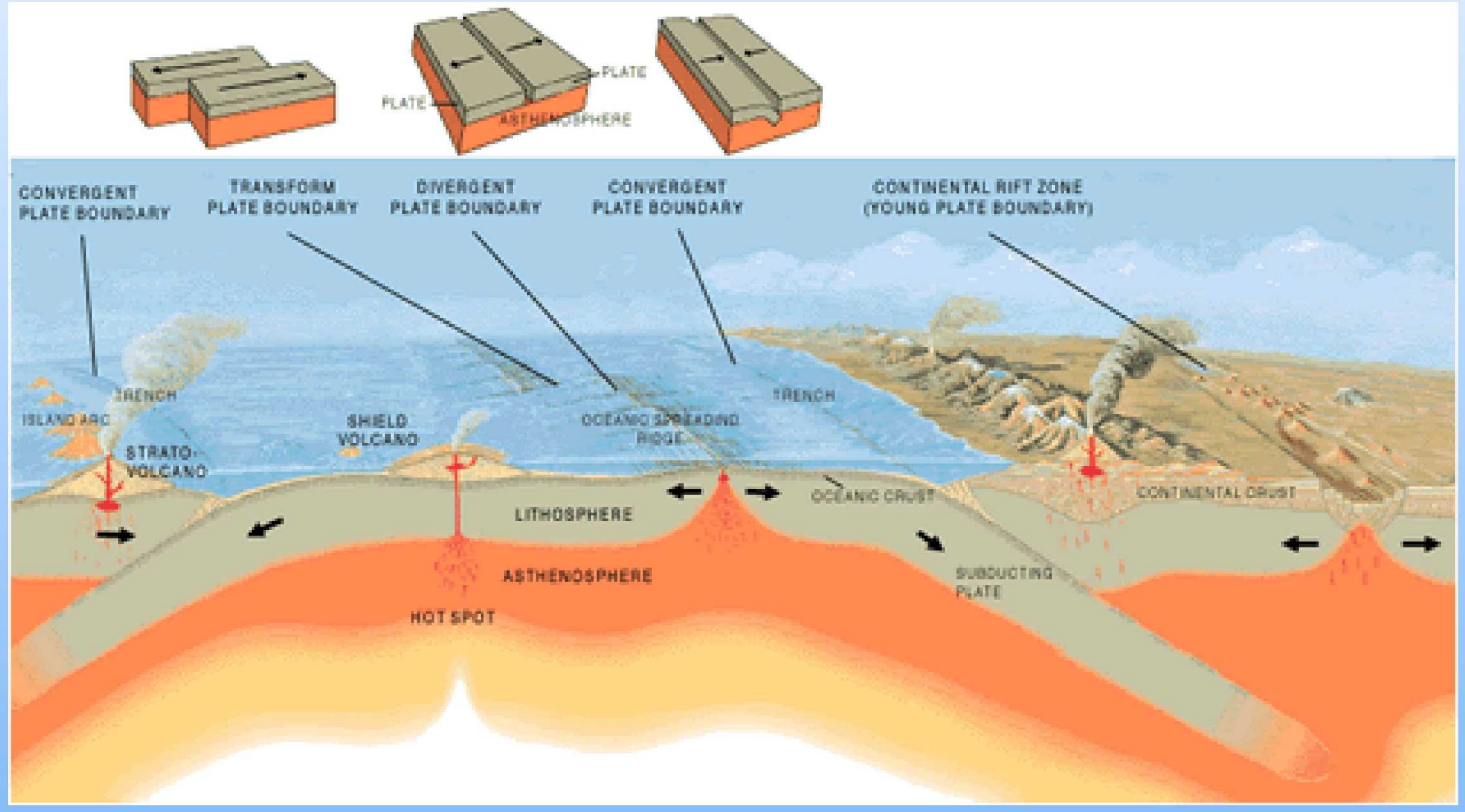
Earth's Major Plates



Major tectonic plates of the world.

Ritter, Michael E. The Physical Environment: an Introduction to Physical Geography. 2006. Date visited, 12/16/2009. http://www.uwsp.edu/geo/faculty/ritter/geog101/textbook/title_page.html

Convergent, Divergent, Boundaries



From *The Dynamic Earth,* USGS Publication

Plate tectonics and volcanoes

- Plate motions provide the mechanism by which mantle rocks melt to form magma
  - Convergent plate boundaries
    - Descending plate partially melts
    - Magma slowly rises upward
    - Rising magma can form
      - Volcanic island arcs in an ocean
        - Develop roughly parallel to the associated trench

Sarychev Volcano, Kuril Islands

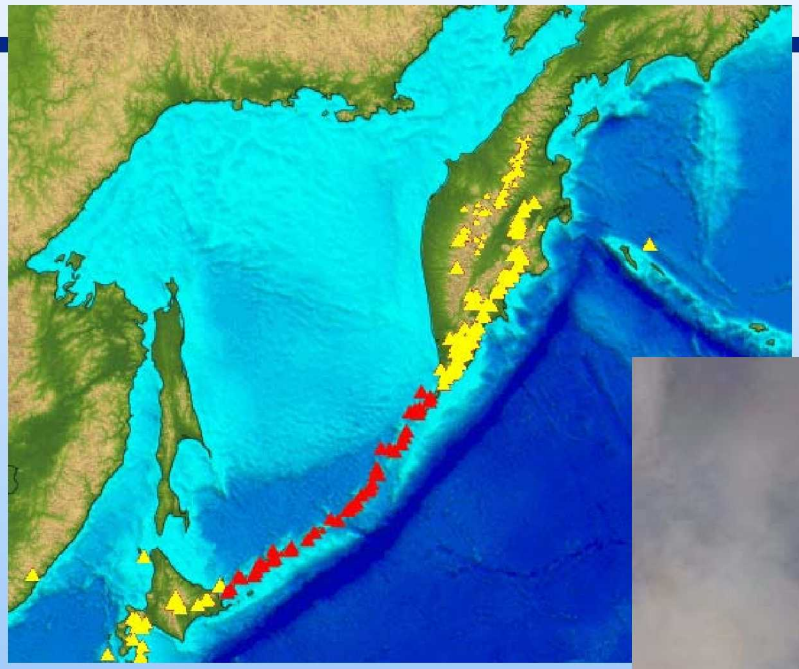


Plate tectonics and volcanoes

- Continental volcanic arcs (Andes Mountains)
  - Through the assimilation of silica-rick crustal rocks a magma body may change composition as it rises through continental crust

Plate tectonics and volcanoes

- Plate motions provide the mechanism by which mantle rocks melt to form magma
  - Divergent plate boundaries
    - The greatest volume of volcanic rock is produced along the oceanic ridge system
      - Lithosphere pulls apart
      - Less pressure on underlying rocks
      - Partial melting occurs
      - Large quantities of fluid basaltic magma are produced

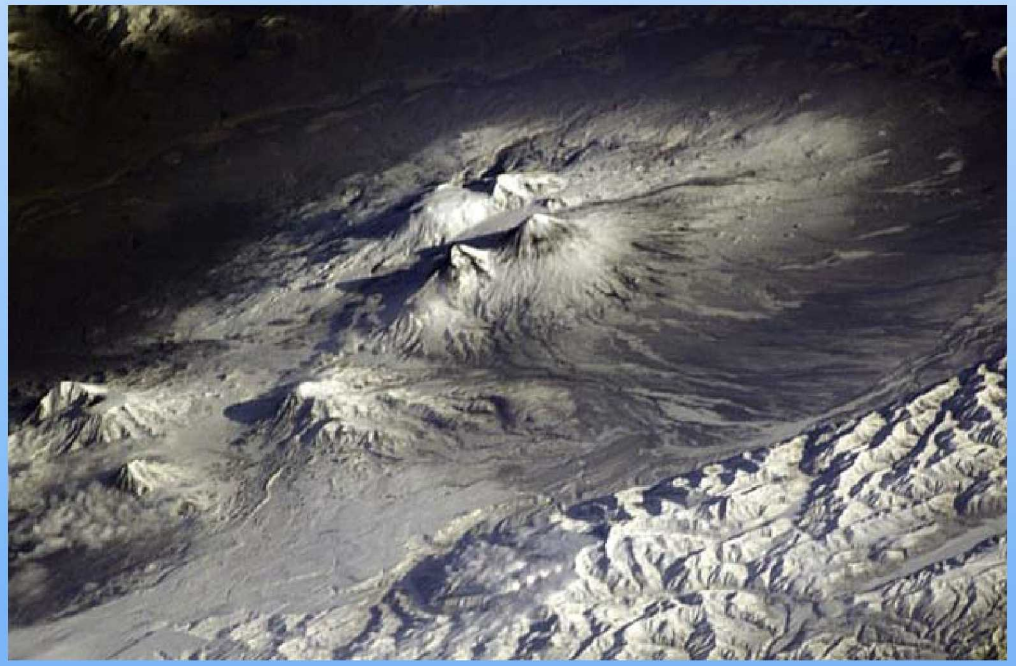
Plate tectonics and volcanoes

- Plate motions provide the mechanism by which mantle rocks melt to form magma
  - Intraplate igneous activity
    - Activity within a rigid plate
    - Plumes of hot mantle material rise
    - Form localized volcanic regions called hot spots
    - Examples include the Hawaiian Islands and the Columbia River Plateau in the northwestern United States

Volcanoes Review – What Kind of Volcanoes are These?

STS110-E-5751, 400 mm,
April 15, 2002

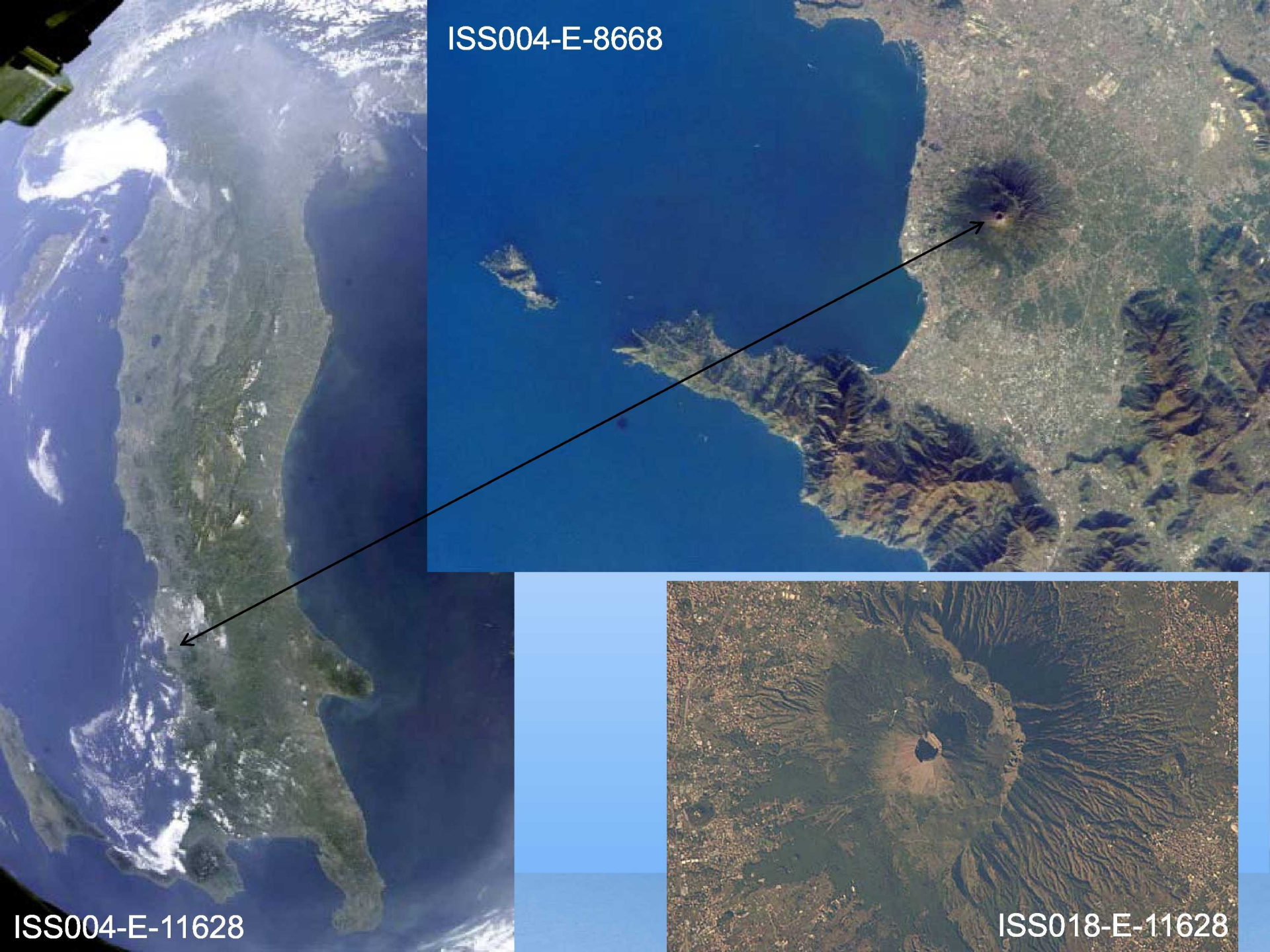
ISS004-E-11488, 400 mm,
May 2, 2002



Mt. Etna, Sicily

200 mm, Oct. 30, 2002

800 mm, Oct. 30, 2002


ISS004-E-8668
ISS004-E-11628
ISS018-E-11628

Mount Pinatubo, Philippines

Damage from Mount Pinatubo Eruption

Questions??